CSIR NEWS

VOL. 20 30 NOVEMBER 1970 : 9 MARGASHIRSHA 1892 NO. 22

Composite Pavement Construction Technique

Investigations have been successfully carried out by the Central Road Research Institute (CRRI), New Delhi on the development of composite pavement construction technique using semi-rigid base of lime-puzzolana concrete under flexible topping with a view to obtaining an economic solution to the problem of pavement distress under adverse soil and climatic conditions. For making lime-puzzolana concrete, both burnt clay puzzolana (reactive surkhi)—a material developed and standardized at CRRI—and fly ash were used.

In view of the superior load dispersion characteristics due to flexural rigidity and increased durability under adverse soil and climatic conditions, such a composite construction is eminently suited in areas where ground-water table is high and subgrade is weak. Preliminary comparative cost analysis (taking the Central Public Works Department schedule of rates 1967 for Delhi and its neighbouring region for estimate purposes) shows that composite construction will be somewhat cheaper than the conventional flexible pavement for medium to heavy category of traffic.

The properties of lime-puzzolana concrete investigated in the laboratory are: compressive and flexural strengths, modulus of elasticity, extensibility, Poisson's ratio and drying shrinkage; and tests conducted include those for ultimate load-carrying capacity and equivalency factors in terms of granular materials. Such concretes, if properly designed, can provide a minimum 28 days compressive strength of 40 kg/cm^2. Other factors remaining the same, the strength of concrete will depend on the lime-reactivity of puzzolana. It has been found that 1 cm of lime-burnt clay puzzolana concrete (1 lime: 2 burnt clay puzzolana: 6 sand: 11 coarse aggregate by wt) and lime-fly ash concrete (1 lime: 2 fly ash: 3 sand: 6 coarse aggregate by wt) are equivalent to 2.5 cm and 1.8. cm of granular base material respectively. The design procedure suggested by CRRI for composite construction consists of first calculating the thickness as per C.B.R. method with the adoption of appropriate equivalency factor and then checking the load factor of the semi-rigid slab for ultimate load.

Besides studies in the laboratory and development of design procedure for such construction, field lengths were laid on the National Highway No. 2. The performance under heavy national highway traffic during the past three years has been very satisfactory.

Based on the work conducted at the institute, the Indian Standard Specifications for lime-puzzolana mixture were issued in 1967 and the Indian Standard Code of practice for the preparation and use of lime-puzzolana concrete in buildings and roads has been finalized. The Indian Roads Congress has also recommended the use of lime-puzzolana concrete as base and sub-base under flexible and rigid surfacings respectively. Recently, the Central Assessment Committee of the Union Ministry of Parliamentary Affairs, Shipping and Transport have recommended sizable trials of composite construction using lime-burnt clay puzzolana concrete as base under flexible topping in U.P. and Haryana.

Oxidation Reactions of Coal Tar Products

With the object of developing processes for the production of chemicals from coal tar fractions, Shri C.S.B. Nair initiated investigations at the Central Fuel Research Institute, Dhanbad under the guidance of Dr A. Lahiri. The studies covered the catalytic vapour phase oxidation of polynuclear hydrocarbons such as naphthalene, methylnaphthalenes, anthracene, phenanthrene as well as coal tar fractions rich in these compounds, to phthalic anhydride and anthraquinone over fluidized beds of catalysts.

The oxidation of coal tar fractions containing predominantly methyl- and dimethylnaphthalenes over a silica based catalyst containing vanadium pentoxide showed that such fractions could yield substantial quantities of phthalic anhydride. It was also shown that tar oils could be used without separating the naphthalene present, whereby yields of phthalic anhydride in excess of those obtainable from the actual naphthalene content could be realized. Oxidation of tar fractions, however, resulted in the production of considerably more heat than in the case of naphthalene. Even then it was found that oxidation of naphthalene oils offered distinct advantages. When tar fractions rich in three-ring structures were used as feed, a considerable part underwent complete oxidation and the yields of phthalic anhydride did not exceed 29%. Hence these fractions did not appear to be promising feed materials for the production of phthalic anhydride.

The oxidation of anthracene and anthracene rich fractions of coal tar were studied in detail for the production of anthraquinone—a chemical for which there is a growing demand in the country. Examination of over fifty different catalysts consisting of various oxides such as Cu_2O, Cr_2O_3, Fe_2O_3, MnO_2, MoO_3 and V_2O_5 deposited on silica gel and promoted by various salts resulted in the development of a catalyst which gave consistently high conversions of anthracene at high selectivity to anthraquinone. Under optimum conditions, 91-96% weight yields of anthraquinone, based on the anthracene content of the feed, could be obtained at space-time yields 80, catalyst temperature 370-450°C,

contact time 2 sec and air/hydrocarbon ratio 11.5. The catalyst was found to have long active life.

Surface area studies, X-ray studies and detailed chemical analysis of the catalyst were made at various stages of its use. The studies provided explanations for the high activities and long active life of the catalyst.

The oxidation of anthracene was found to be first order with respect to the initial concentration of anthracene and 0.93 order with respect to the initial oxygen concentration. The reactions leading to the production of anthraquinone, phthalic anhydride and carbon dioxide were also found to have a first order dependence on the initial anthracene concentration.

The reactions involved in the oxidation of anthracene were studied following a parallel and consecutive sequence of reactions. It was shown that a scheme of simultaneous and consecutive reactions could explain the observed facts satisfactorily. The energies of activation for the individual reactions were calculated, which indicated a predominantly surface reaction controlled mechanism. Under the experimental conditions, the reaction leading to the production of anthraquinone is the fastest reaction. Reactions leading to the production of carbon dioxide and phthalic anhydride were respectively 4-5 times and 29-33 times slower than the reaction leading to the production of anthraquinone depending on the temperature of the reaction.

The overall kinetics of the oxidation of anthracene was studied employing a modified equation derived from that of Mars and Van Krevelen, based on the assumption that the anthracene is oxidized by the catalyst which gets reduced in the process and that in the second step the reduced catalyst is oxidized by the oxygen of air to its original state. The reoxidation by oxygen of the reduced catalyst was found to be 4-7 times slower than the oxidation of anthracene by the catalyst and hence this is taken to be the rate determining step. This indicated that the influence of the concentration of oxygen was greater than that of anthracene in the overall reaction mechanism.

Shri C. S. B. Nair was awarded the Ph.D. degree (1970) of the Kerala University, Trivandrum for the thesis entitled 'Oxidation reactions of coal tar products.'

WHO International Conference on Community Water Supply

Prof. S. J. Arceivala, Director, Central Public Health Engineering Research Institute, Nagpur represented CPHERI at the conference on 'Research and Development in Community Water Supply', organized by the World Health Organization at Dubrovnik, Yugoslavia from 7 to 14 October 1970. The institute is one of the WHO Collaborating Institutions in Community Water Supply. Over 40 participants from 28 different countries attended. Prof. Arceivala was elected vice-chairman for the conference.

Speaking on the 'Role of Collaborating Institutions in Developing Countries' Prof. Arceivala reiterated the aim of WHO in setting up a family of collaborating Institutions all over the world for Community Water Supply, which is to provide facilities for aiding and expediting research and development in this field, to reduce duplication of effort, and to serve as a catalyst for the solution of local problems largely through local endeavour. The primary objective of any collaborating institution in a developing country, Prof. Arceivala elaborated, is to ensure that the national water supply programme is better planned and more effectively implemented so that water could be provided to more people, more quickly, more safely and less expensively. In playing this role, the institution has to fulfil certain national and international responsibilities. It should (i) take a continuing interest in the national water supply programme; (ii) devote skills and ideas to the identification and solution of the country's water problems; (iii) encourage, assist and train individuals to accomplish the needed tasks; (iv) keep abreast with modern techniques and ideas through exchange of information, scientists, etc.; (v) act as liaison with fellow-workers all over the world; and (vi) serve as focal point of national activities for research and development in community water supply.

Prof. Arceivala congratulated WHO for providing exciting possibilities for creative and collaborative work by way of setting up a machinery of WHO collaborating institutions for a fruitful exchange. There could be no better opportunity than this for coordinating research and development policies and practices so that a coordinated approach may be made to these problems which is so vital to hundreds of millions of people throughout the world.

Prof. Arceivala apprised the participants of the work which CPHERI has done in the field of community water supply such as development of simple devices for disinfection of water, development of inexpensive medium for defluoridation of waters, etc. which have immediate impact on community water supply problems.

The conference attracted worldwide interest as a large number of directors of research institutions from all over the world participated. Matters of topical interest, such as the increasing pollution of the world's water supplies and the spreading menace of the waterborne epidemics were discussed together with the more fundamental problems of the developing countries in which it has been estimated that 90% of the population are without safe and adequate water supplies for drinking and domestic purposes. The conference chalked out a programme of future research and development work in this field.

Asian Regional IHD National Committees' Meeting

The first meeting of the International Hydrological Decade (IHD) National Committees of the Asian Regions was held at Bangkok from 5 to 11 October 1970 in accordance with the recommendations of the fifteenth session of the General Conference of UNESCO for discussing the problems of hydrology in Asia and to advise the UNESCO Secretariat on the ways and means of promoting intensive cooperation in the region. Nineteen out of 21 national committees sent their delegations. The Council of Scientific & Industrial Research sponsored the Indian delegation consisting of the Chairman of the national committee Dr K. R. Ramanathan, the

Secretary Shri S. Banerji and two experts, Shri P. R. Ahuja, Chairman, Tungabhadra Board and Shri B. N. Neogi, Senior Geologist of the Geological Survey of India.

Emphasizing the great variety of hydrological and geographical characteristics of the region which should be taken into consideration in formulating plans for regional cooperation in hydrology, the meeting recognized the need for increased international assistance in the form of experts and equipment. India, along with Australia, Japan and New Zealand, indicated her readiness to cooperate in rendering such assistance, by supply of experts and equipment, the latter particularly in the field of establishment of hydro-climatic stations and groundwater stations. India's offer to act as coordinator for the preparation of the regional hydrogeological maps conveyed to the meeting of Working Party of senior geologists and Sub-committee on Mineral Resources Development, held in Bandung from 20 to 31 August 1970, was also reiterated in the meeting.

Other important recommendations arising out of the deliberations of the meeting are as follows :

(1) The Asiatic regions may be divided into hydrological regions at an early date and the classifications of these different divisions, which will promote international cooperation in the application of results of research in representative basins, may be carried out by the UNESCO Working Group on Representative and Experimental Basins.

(2) Basic data and results of research of such basins on large rivers, which traverse more than one sovereign country, should be exchanged under bilateral or multilateral agreement between the countries concerned.

(3) That UNESCO approach the governments of countries like Australia, India, Japan and New Zealand, which have established efficient instrument workshops to offer training facilities to other regional countries and make available guides for efficient operation of hydrological instruments.

(4) Studies on hydrological problems created by urbanization, particularly water pollution, should be conducted.

(5) That UNESCO establish three or four regional training schools for technicians.

The UNESCO was requested to hold in collaboration with ECAFE symposia/seminars on groundwater resources development and on the latest techniques on data collection, processing, storage and retrieval of hydrological data respectively.

PROGRESS REPORTS

CGCRI Annual Report : 1969

The research and development programmes of the Central Glass & Ceramic Research Institute (CGCRI), Calcutta during the year 1969 were geared towards making the country self-reliant in essential raw materials and products, improving the quality and lowering the cost of the existing production, assisting the industry in the technological problems and meeting the defence requirements. The annual report of the institute for 1969, which has been published recently, reveals that the major pilot plant projects were concerned with the production of radiation-shielding high density lead glass windows and synthetic quartz crystals. The furnaces and equipment required for melting, casting and annealing of large slabs of radiation-shielding glass were fabricated and commissioned. A wire-sawing machine was designed and successfully used for cutting large slabs. Small windows of 15 cm × 15 cm surface area were being produced for the Bhabha Atomic Research Centre, Bombay. Based on laboratory scale results, a prototype of the pilot scale autoclave for the production of synthetic quartz crystals was designed and fabricated. Investigations were continued on the effect of solvent composition on growth rate and causes of cracking of large crystals. A project of special significance to aero-engine industry under investigation at the institute is concerned with the development of special enamel compositions required for exhaust systems of jet engines for protection against high temperature corrosion, oxidation and chemical action of exhaust gases. At the instance of the Gas Turbine Research Establishment (GTRE), Ministry of Defence, New Delhi, the institute developed suitable enamels which were successfully tested for their performance by GTRE. A process of solution ceramics was examined for developing protective coatings for aluminium and its alloys used in the fabrication of aero-engine parts. Various combinations of aqueous solutions of zirconyl nitrate, chromic nitrate, nickel nitrate and aluminium nitrate yielded some good adherent coatings.

Modifications were effected in the preparation and firing of glass-to-metal seals employed in the electronics indusrty and the process was assigned to a firm. Metallized high alumina ceramics, extensively employed in electronics industry, are at present imported. At the instance of the Solid State Physics Laboratory (SSPL), Ministry of Defence, New Delhi, and the Central Electronics Engineering Research Institute, Pilani, a project on the development of high alumina ceramic seals and spacers was taken up by CGCRI. The high temperature ceramics and the technique of metallization have been developed for the first time in the country. The alumina ceramics are characterized by excellent mechanical strength, low dielectric loss, higher stability at operating temperature and favourable thermal expansion. Five hundred pieces of spacers of different sizes were supplied to SSPL for use in electronic equipment. The commercial production of the ceramic spacers is expected to result in a considerable saving of foreign exchange.

The Hindustan Sanitaryware Industry Ltd, Bahadurgarh, commissioned a plant for manufacturing opacifiers from indigenous zircon sand (available in Kerala) on the basis of the know-how developed by the institute. The opacifiers replaced up to 67% the imported material in the sanitaryware glazes. Zircon opacifiers produced on the basis of the institute's process are being utilized by a number of ceramic factories. In view of the high cost and scarcity

of zinc oxide, an essential ingredient of sanitaryware glazes, the institute developed a suitable zinc-less glaze for vitreous china sanitaryware and 300 kg of the glaze were produced in a plant in Gujarat and supplied to two sanitaryware units for trial.

A new family of alkali-free vitreous materials having low-thermal expansion and favourable electrical properties, which are suitable for making crucibles, basins, tubes, hot plates and immersion heaters, etc., have been developed. Investigations on the development of ion electrodes were undertaken with a view to providing small laboratories with a simple low cost analytical tool suitable for rapid and accurate estimation of alkali ions. Two glass compositions suitable for making sodium ion electrodes were developed. In view of the importance of lithium chemicals in the preparation of multipurpose greases, welding electrodes, special glass and ceramics, etc., a process has been developed by the institute for producing technical grade lithium carbonate on a laboratory scale from indigenous lepidolite.

Work on the evaluation, beneficiation and utilization of glass raw materials, clays and ceramics and refractories and evaluation of Indian mica pegmatites was continued. Several samples of silica sand and quartz occurring in Gujarat were studied for their suitability in glass manufacture. Two such samples were found suitable for making optical glasses.

Other applied research projects undertaken by the laboratory were concerned with : development of glass compositions for fixation of high level atomic waste; mineralogical studies on clays and clay products with a view to assessing their suitability for use in industries; studies on Indian fire clays; studies on stabilization of dolomites; studies on Indian vermiculites; analysis of chrome-bearing materials, and nucleation and controlled crystallization of glasses.

A rapid and accurate procedure was worked out for the complete analysis of chrome ores and chrome refractories; the method does not involve the use of rare chemicals and sophisticated instruments. Improvements were effected in the titrimetric method for the rapid estimation of potassium developed earlier; as a result the method was found superior to the flame photometric method when potassium content is high ($> 10\%$).

The laboratory developed a new type of fluctuation-free glass electrode suitable for use in the direct reading *p*H meter. On a request from the Railways, a few hundred litres of mica base fire retardant paints were produced and supplied.

Boron-free transparent enamel frit composition was modified to make it suitable for industrial production; a firm has successfully started the manufacture. Steatite porcelain, which is widely employed in making electrical and radio frequency electronic components, is mostly imported. Suitable compositions using indigenous raw materials were developed and firing conditions standardized. The casting properties of the steatite compositions were studied and some dies for preparing pressed shapes were designed. The entire process is being utilized by a number of ceramic units in the country.

Special refractory articles worth about Rs 35 000 were supplied to various steel plants, research institutions, industries and other organizations. Glass electrodes and reference electrodes valued at Rs 36 000 were supplied to various parties. Enamel frits, enamel stains, ceramic colours and special glass colours worth about Rs 38 000 were produced and sold. Electronics and Industrial Instruments Co. Ltd, Hyderabad, who are manufacturing the three types of glass electrodes, are being supplied *p*H sensitive glasses by the institute.

The following three processes were released to industry for commercial utilization: (i) decoloration of clays; (ii) chemical porcelain; and (iii) glasses for glass-to-metal seals of electrical devices. Another process relating to chemical toughening of glass was under negotiation for release to industry.

The role of tin in copper ruby glass; phase equilibrium studies in the BeO-Na_2O system; chemistry of cements, high temperature DTA of magnesite, and high temperature study of basic refractories are some of the fundamental research projects being tackled by the institute.

Thirty-six research papers were published by the institute during the year under review.

PROCESSES READY FOR COMMERCIAL UTILIZATION

Tannin Extracts

The total production of myrobalans, abundantly available in the country, amounts to about 80 000 tonnes per annum, out of which about 10 000 tonnes are annually consumed by myrobalan extract manufacturing factories. Although myrobalan is extensively used in the final stages of tanning processes, it cannot be employed unlike wattle as a self-tanning material.

About 20 million kg of wattle valued at Rs 2.85 crores are imported at present. With a view to making the indigenously available myrobalan a self-tanning material so that a partial substitution of imported wattle could be achieved, the Central Leather Research Institute (CLRI), Madras has developed processes for the production of tannin extracts designated Tannin Extract G and Tannin Extract H, which result from the addition of some inorganic chemicals to myrobalan extracts.

The products (1) are useful in the manufacture of different types of leathers, particularly sole leathers; (2) can be used along with other tanning extracts/materials; and (3) can also be employed independently, although it is preferable to add some amount of wattle extracts in the production of sole leather. The products, prepared both on pilot scale and commercial scale, have been tested by the tanning industry.

The total capital outlay for erecting a plant for the production of 1500 tons per annum of Tannin Extract G has been estimated at Rs 14 lakhs and the cost of production at Rs 1100 per tonne, provided the raw myrobalans are available at Rs 125/tonne. The corresponding figures for Tannin Extract H are Rs 15 lakhs and Rs 1150.

Parties interested in undertaking the commercial production of the above products may write to: The Secretary, National Research Development Corporation of India, Mandi House, Lytton Road, New Delhi 1.

CSIR SUPPORT TO RESEARCH

New Schemes

Optical, Electrical and Semi-conducting Properties of Polymers

Organic molecules with a conjugated double bond could possess metallic conductivity and this idea has given rise to a number of studies directed towards obtaining conducting or semi-conducting polymeric materials possessing chains of conjugated double bonds. Semi-conducting polymeric materials are finding wide applications in electronics. The semi-conducting properties of polymers will be the subject of investigation of a new CSIR scheme granted to Dr N.K. Sanyal of the Department of Physics, Gorakhpur University, Gorakhpur. It is proposed to study (1) optimum conditions for the phase change of certain polymers from non-conducting to semi-conducting stage and to make a comparative study of their physico-chemical properties in the two phases; (2) the effect of different irradiations on the optical, electrical and electronic properties of polymers; and (3) electronic properties of polymeric single and poly crystals. The development of a few semi-conducting and luminescent polymers is also envisaged.

Organic Excimers, Dimers and Dimer Ions

The phenomenon of excimer fluorescence in aromatic substances has been a subject of considerable interest for some time. An excimer is an excited dimeric species which is stable only in the excited state and repulsive in the ground state so that one can see the emission only. Dimers of aromatic hydrocarbons can remain stable even in the ground state provided they have the geometry of a partly open book. A theoretical study of organic excimers, dimers and dimer ions forms the subject of investigation of a new CSIR research scheme granted to Dr A. K. Chandra (principal investigator) of the Department of Inorganic and Physical Chemistry, Indian Institute of Science, Bangalore. Dr Chandra proposes to study, within the framework of the semi-empirical theory of excimers developed earlier by him, the possibility of computing the potential energy of the excited dimers as a function of tilt and hence potential energy curve. The object of the study is not only to confirm the existence and establish the geometry of the dimeric species other than the excimers but to obtain other relevant spectroscopic data on dimers and excimers.

Dimer cations and anions are known to exist as stable species long before the existence of organic dimers in the ground and excited states was established. A systematic study of the dimer ions within the framework of the semi-empirical theory will lead to the understanding of the forces responsible for the molecular association or the formation of aggregates in solids.

The studies will not only lead to a better understanding of the nature of bonding between two neutral molecules and hence in polymers but of the chemistry of the solid state and the mechanism of the molecular luminescence.

Electronic Spectra of Molecules

A new CSIR scheme sanctioned to Prof. Mihir Choudhury of the Department of Chemistry, Presidency College, Calcutta envisages a study of the polarized spectra of organic and inorganic single crystals at temperatures down to 20°K in order to assign the bands and compare the energies and intensities with the values calculated theoretically. The magnetic properties of the excited triplet states of organic molecules will be investigated in view of the significant role of the triplet states in photochemical and biological processes. The polarization properties of charge-transfer phosphorescence will also be the subject of investigation.

Molecular Complexes

A new CSIR research scheme granted to Dr D. C. Mukhopadhyay (principal investigator) at the College of Science, Calcutta University, Calcutta is concerned with a study of molecular complexes. The object of the scheme is to examine the role of ionization potentials and electron affinities in determining the extent of charge-transfer interaction and to make a critical study of some molecular complexes in the light of Mulliken's charge-transfer theory. For this purpose the donor-acceptor interaction will be analysed using different π- and n-donors and π- and σ-acceptors belonging to biomolecules. Attempts will also be made to discuss the probable geometrical configurations of the complexes. It is also proposed to study the amphoteric characteristics of some of these biomolecules making use of their capacity to form charge-transfer complexes.

Spectroscopic and Quantum Chemical Studies on Biologically Important Molecules

The application of molecular orbital method to the π-electron systems in explaining the proton tunneling in hydrogen bonded systems, inter-molecular charge fluctuations, electronic aspects of mutagenesis and carcinogenesis, energy transfer by excitons and mechanisms underlying hypochromism has received the attention of workers. Under a new CSIR scheme sanctioned at the Department of Spectroscopy, Faculty of Science, Banaras Hindu University, Varanasi, Dr Devendra Kumar Rai (principal investigator) proposes to study the carcinogenic activities of the molecules at various receptor surfaces in the biological system with a view to finding out suitable chemicals which may arrest these activities. He also proposes to probe into the mechanism of the replication of DNA and to understand the action of various chemicals and ultraviolet radiation in inducing proton tunneling which leads to the growth of tumours.

Effects of Ultraviolet Light on Amino Acids

The effect of ultraviolet light of different wavelengths on aqueous solutions of amino acids in the presence and absence of photosensitizers is the subject of investigation of a new CSIR research scheme granted to Dr Rashid Ali (principal investigator) at the Department of Biochemistry, Jawaharlal Nehru Medical College, Aligarh Muslim University, Aligarh. It is also proposed to elucidate the reaction mechanisms and to study the phenomenon of transamination and transamidation in the presence of ultraviolet light.

Studies on Wall Jets and Wall Wakes in Hydraulic Engineering

In practice the outlet from a hydraulic structure may assume various relative dispositions with respect to the downstream channel in terms of the shape, elevation above the bed, amount of submergence, etc. These situations can be classified, as a first approximation, into a few basic categories, and the behaviour of flow, viz. the velocity, pressure and bed shear distributions can be studied in detail. This information will not only enable fairly accurate analytical methods to be developed but will also help evolve rational design criteria for a safe and economical design.

While sufficient information is available on wall jets on smooth boundaries, not much information is known about wall jets subjected to separation and reattachment. In particular, the behaviour of a wall jet when it encounters an obstruction like a baffle pier in a hydraulic jump has not been studied. Similarly, in the case of wall wakes the resulting eddy size, the velocity and pressure distributions for various body shapes will enable a better understanding of the functions and behaviour of isolated and combined blocks and other obstructions commonly used in hydraulic engineering.

The present practice of stilling basin designs is empirical to a large extent and an understanding of the mechanics of flow is lacking. Hence, an application-oriented study of wall jets and wall wakes with special reference to hydraulic engineering would be of great value. This is the object of a new CSIR scheme sanctioned to Dr K. Subramanya (principal investigator) of the Indian Institute of Technology. Kanpur. It is proposed to carry out the studies in three phases. The first phase will involve : (i) studies on wall jets under adverse pressure gradients in a wind tunnel and measurements of velocity, shear stress and turbulence distributions; (ii) studies on reattached wall jets as in (i); and (iii) development of a mathematical model of the flow phenomenon.

The second phase comprises : (i) basic studies on wall wakes in a wind tunnel; (ii) basic studies on wall wakes in gravity field in an open channel; and (iii) development of a mathematical model.

The last phase will be devoted to (i) studies on forced hydraulic jump with a view to explaining the phenomenon in the light of experience gained in the first two phases; and (ii) development of design criteria for stilling basins employing forced hydraulic jump.

Three-dimensional Stress Distribution in End Blocks of Prestressed Beams

Extensive theoretical investigations on the three-dimensional stress distribution in prestressed end blocks have been made at the Department of Civil Engineering, Indian Institute of Science, Bangalore. However, the theoretical solutions do not take into account the existence of ducts or holes provided for the cables, which are normally grouted only after the wires are prestressed. As the end blocks and holes differ in geometry it is difficult to obtain a theoretical solution to this problem. The theoretical solution would however be useful in evaluating experimental results. Under a new CSIR scheme granted to Prof. K. T. Sundara Raja Iyengar (principal investigator) and Dr K. Chandrashekhara (co-principal investigator) of the Department it is proposed to conduct extensive tests on epoxy and concrete models and experimentally determine the stresses using photoelasticity and Moire and strain gauge techniques. It is also proposed to conduct tests on concrete models to obtain the stress distribution on the surface as well as in the interior. The results of the tests are expected to lead to a rational procedure for the design of end blocks in post-tensioned prestressed concrete beams.

Load Distribution in Torsionally Stiff Inter-connected Skew Bridge Girders

Though a large number of skew bridges are constructed, very little is known about the load distribution in the girders of inter-connected skew bridges. In a new CSIR scheme sanctioned at the Civil Engineering Department, Indian Institute of Technology, New Delhi it is proposed to develop a general method of analysing and designing inter-connected skew bridges. The principal investigator of the research scheme is Dr Chandra Singh Surana. The method will meet the following essential requirements: (i) applicability to bridges having zero, finite or infinite torsional stiffness; (ii) applicability to bridges having any number of longitudinal girders; (iii) capability of giving correct value of deflections, slopes, rotations, bending moments, torsional moments and shears; and (iv) suitability for design office use.

Study of Hyperfine Fields using Perturbed Angular Correlation Techniques

Electron polarization at the nucleus can give rise to large magnetic fields at the nuclear site. These large fields have been particularly helpful for the study of the magnetic properties of the nuclear excited states. Dr G. N. Rao, the principal investigator of a new CSIR research scheme, sanctioned at the Department of Physics, Indian Institute of Technology, Kanpur proposes to measure the hyperfine fields at the nucleus in the ferromagnetic and paramagnetic hosts. The nuclei of the dilute impurity metals introduced in the host matrices of ferromagnetic and paramagnetic substances will have large hyperfine fields. Often the existence of localized bound states of the 'Konde' type can be detected if the impurity hyperfine field does not follow the hyperfine fields of the host matrix. Measurements of the hyperfine field on different metal impurities in the host matrices of Fe, Co and Ni as a function of temperature in the range 4.2°K-1000°K will be made.

The 4f electrons can give rise to large enhancement factor for the magnetic field at the nucleus. It is also proposed to measure the paramagnetic enhancement factors in paramagnetic substances as a function of temperature with a view to comparing them with the theoretical calculations.

Aerodynamic Interference of Blades on Cascade Performance

Under the purview of the Aeronautical Research Committee, a new CSIR scheme tenable at the Department of Mechanical Engineering, Jadavpur

University, Calcutta, has been granted to Prof. B. N. Chanda (principal investigator). The objective of the scheme is to study the effect of mutual interference between two rows of blades of axial flow machines on the performance by making a theoretical study of the performance of tandem cascade using Acherets and Schlichtings approaches. It is also proposed to make experimental studies of (i) the effect of axial clearance and displacement factor on overall performance of tandem cascade; and (ii) the flow separation in blades for different relative positions so that a prediction of the performance of axial flow compressors could be made at the design stage.

Age Determination and Uranium Concentration by Fission Track Studies

Fission track dating method is the latest addition to the field of geochronology which, since its discovery in 1963, is finding diverse applications in many branches of science and technology. Dr K. K. Nagpaul (principal investigator) has been granted a new CSIR scheme under the purview of the Physical Research Committee, tenable at the Department of Physics, Kurukshetra University, Kurukshetra. The research scheme aims at the determination of age and uranium concentration of minerals, waters, archeological samples and lunar samples employing the fission track dating method. The investigation will help in tracing the thermal history of the region under study.

Diversity of Igneous Rocks of Mundwara (Rajasthan)

There are three separate hills in the vicinity of Mundwara village (Sirohi Distt, Rajasthan). The constituent rocks in the region contain a complex of igneous suite, which includes all the three phases, viz. plutonic, hypabyssal and volcanic. The plutonic rocks range in composition from ultra basic to sub-basic types (diorite); the hypabyssal phase is represented by dolerite dykes, whereas the volcanic phase is of acidic composition (rhyotites). Whether all these widely varying types are connected with one and the same magmatic cycle or form parts of different ones is not known. So far, no systematic work has been done on these rocks, and it is therefore proposed to undertake a detailed study of this region under a new CSIR scheme sanctioned at the Department of Geology, University of Delhi, Delhi. Dr G. S. Roonwal of the Department is the principal investigator in the research scheme.

After a general quick survey, detailed mapping will be carried out to mark out the different rock groups within the Mundwara complex. Systematic ground as well as vertical sampling will be done and the petrological studies carried out with special emphasis on the plagioclases and pyroxenes. Chemical analyses of a few rocks and minerals, the plagioclases and pyroxenes should yield ample data to work out the complete crystallization and differentiation process or any other event, which resulted in the diversity of composition and texture in Mundwara area.

The petrological work would be done at the Department of Geology, Delhi University. The petrochemical investigations would be carried out in the Aligarh Muslim University laboratories.

Completed Schemes

Nuclear Structure Studies in Hartree-Fock Representation

A study of the static properties of light nuclei which are obtained in the Hartree-Fock calculations with realistic interactions has been made by Miss Indira Kakkar, a CSIR research fellow, under the supervision of Dr Y.R. Waghmare at the Department of Physics, Indian Institute of Technology, Kanpur. Spherical Hartree-Fock calculations have been carried out for the ^{4}He, ^{8}Be, ^{12}C and ^{16}O nuclei with the following two interactions: effective interaction of Shakin, Waghmare and Hull derived from Yale potential using a unitary-model-operator approach and the Sussex interaction of Elliott *et al.* obtained directly from experimental phase-shift data using an auxiliary potential method. The properties calculated are the binding energies, the single particle energies, matter and charge rms radius, matter and charge densities, spin-orbit splittings, etc. Two important corrections due to coulomb energy and the centre-of-mass motion of the nucleus have been included in a self-consistent manner in the calculations.

The binding energy results obtained with effective Yale interaction for all the nuclei considered have been found to be in satisfactory agreement with the corresponding experimental values if all the second-order terms of the Yale potential are accounted for. Sussex matrix elements give better results for the binding energies in the first-order compared to the truncated results of other realistic interactions. The rest of the calculated properties are in fair agreement with the experimental data. Single-particle wave functions and the self-consistent single-particle potentials obtained in the Hartree-Fock calculations with effective Yale interaction have been studied in detail. The Hartree-Fock single particle wave functions for ^{16}O have been compared with the conventional harmonic oscillator wave functions. It is observed that the Hartree-Fock wave functions are damped inside at smaller distances, but have longer tails compared to the harmonic oscillator wave functions. The general nature of these wave functions is the same for all the nuclei. The Hartree-Fock single particle potential is non-local and state-dependent.

The effects of central, spin-orbit and tensor components of the Sussex interaction on various ground state properties of ^{16}O and ^{12}C nuclei, as obtained in the Hartree-Fock formalism, have been studied. It is observed that a major contribution to the binding energy comes from the central part of the interaction alone. In the case of ^{16}O, almost all of the $lp_{3/2}$—$lp_{1/2}$ splitting comes from the spin-orbit component. However, in ^{12}C the tensor part of the interaction also provides large splitting, but its contribution is of the wrong sign.

The energy levels of ^{18}O, ^{18}F and ^{10}Be have also been studied in the Hartree-Fock representation. It is assumed that the nucleons move independently of each other in a Hartree-Fock self-consistent field and the low-lying states of these nuclei arise due to excitations of only the last two nucleons. The single particle energies and wave

functions describing the behaviour of these nucleons are obtained from Hartree-Fock calculations. The nucleon-nucleon potentials used are the effective Yale interaction and the Sussex interaction. It is seen that the calculated Hartree-Fock spectra are compressed compared to the experimental levels in all the cases. The poor agreement with the experimental results may be due to the nature of the nucleon-nucleon interactions used in the calculations. Both these interactions give 3-4 MeV per particle less binding for finite nuclei in first-order calculations and reasonable values can be obtained only if second-order corrections are taken into account. However, spin-orbit splittings in various nuclei have been satisfactorily reproduced with both these interactions. Thus, it appears that the spin-orbit part of both these interactions is reasonable, but the central part is weak and this is reflected in the energy level calculations. It is also observed that in the restricted configuration space the Hartree-Fock and the harmonic oscillator wave functions give very similar results.

PATENTS ACCEPTED

Indian Pat. 118256

Improvements in or relating to electrolytes for electrochemical marking on metals
S. Guruswamy
CECRI, Karaikudi

The method of electrochemical marking on metals is at present employed for transferring letters, designs and numbers on metals so that metal articles of industry and commerce are marked for the purpose of identification, certificate of quality and for advertisement. The method has the advantages of speed, clarity, permanence, ease of production and minimum damage to the underlying metal. The earlier patent No. 118016 deals with an electrode holder for electrochemical marking of metals.

In this patent, certain specific combinations of electrolytes are given which will enable an etch marking on mild steel, stainless steel and aluminium using direct current. It is possible to effect a satisfactory etch marking in 20-40 sec using a direct current supply of 20-25 V depending on the stencil area and the electrode holder used. In addition to the etch mark using direct current, it is possible to effect etch/deposit mark using ac. The mark is generally black/brown in colour depending on the combination of electrolytes used and is effected in a shorter time. Specific solutions for mild steel, galvanized iron, brass and tin plated materials for marking in 10-15 sec using 20-25 V ac are given.

A combination of electrolytes to effect ac mark on mild steel, stainless steel, brass and galvanized iron in much shorter time (3 to 5 sec) is also given. The chemicals are readily available, cheap and are not harmful to operators employing this method of marking. The chemicals attack the metals least as long as current is not flowing through the solution.

PATENTS FILED

127925 : A new process for the manufacture of menthol (B.P.) from partially dementholized mint oil, P. R. Rao, M. C. Nigam, S. N. Saproo & M. M. Chopra—RRL, Jammu.

127956 : Improvements in or relating to the production of lead powder by direct reduction of lead compounds and/or of active material obtained from discarded or spent lead acid battery plates, H. V. K. Udupa, P. V. V. Rao & Miss R. Vijayavalli—CECRI, Karaikudi.

128101 : A process for the manufacture of cationic synthetic tanning material (Syntan CCN), V. S. S. Rao, K. K. Reddy, K. T. Sarkar & Y. Nayudamma—CLRI, Madras.

128146 : Mechanical salt transporter, R. P. Dhiman & B. S. Purabia—CSMCRI, Bhavnagar.

128381 : Improvements in or relating to the reduction of phosphorus content of high phosphorus manganese oxide ores, S. B. Kanungo, B. R. Sant & G. S. Chowdhury—RRL, Bhubaneswar.

128382 : Improvements in or relating to a water vapour condenser for accelerated freeze drying plant, B. C. Mohanty & A. Parida—RRL, Bhubaneswar.

128412 : Improvements in or relating to the electrolytic reduction of nitrobenzene to aniline, H. V. K. Udupa, G. S. Subramanian & P. N. Anantharaman—CECRI, Karaikudi.

Just Published

LIVESTOCK

(Including Poultry)
Supplement to
The Wealth of India
Raw Materials: Vol. VI (L-M)

Contains sections on Cattle and Buffaloes, Sheep, Goats, Pigs, Horses and Ponies, Donkeys and Mules, Camels, Yaks and Poultry.

Covers all important aspects of Livestock and Poultry such as breeds and breeding, feeds and feeding, diseases, products obtained with data relating to production, utilization, export and import, chemical composition, preservation and processing of milk and milk products, meat and meat products, byproducts, etc.

An exhaustive bibliography and a comprehensive index are also included.

This volume is useful as a reference book for both research workers and those interested in livestock improvement in India and elsewhere.

Pages 288 **Demy 4to** **6 Colour plates + 30 text figures**

Price: **Rs 60.00 Sh. 120 $ 18.00**

Copies can be had from
Sales & Distribution Section
Publications & Information Directorate
Hillside Road
New Delhi 12.

Printed & published by A. Krishnamurthi, Chief Editor, Publications & Information Directorate, New Delhi, at Delhi Printers. Delhi
RN42125